anonymous reviewer of Darwin's *Descent of Man* (1872) in the London *Times* chastized Darwin for being "reckless" in publishing such "disintegrating speculations" in such perilous times. Fifty years later and an ocean away, Bateson was to be given a similar lesson when he claimed at a meeting of the American Association for the Advancement of Science that the "origin and nature of *species* remains utterly mysterious". As might be expected, newspaper headlines declared triumphantly "Darwinism Disproved".

Another 50 years on the scenario was replayed when critics of sociobiology warned that statements made by E.O. Wilson and company could easily be used by racists and

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Down House, at Downe in Kent, Darwin's home from 1842 until his death in 1882.

sexists. These criticisms in turn were taken up by Creationists as more proof that evolutionary theory is false. Even more recently, advocates of a new theory of biological classification termed "cladistics" have proclaimed that cladistic classifications are not about evolution but about patterns of character distributions, no matter how they may have arisen. Rumours of Darwin's death in South Kensington were a result. More recently still, Tom Bethell in *Harper's* has complimented cladists for having a truly scientific outlook. "Only evolutionary agnostics like Patterson and Nelson and other cladists seem willing to live with doubt. And that, surely, is the only truly scientific outlook." As far as Bethell is concerned, the proper attitude towards evolution is the one that Huxley advocated for the existence of God — not proven. On these standards, very little has been proven in science, including relativity theory, quantum theory, not to mention continental drift. The authenticity of the Shroud of Turin is quite another matter. There is no doubting here.

Once again, Creationists are sure to make ample capital out of this intramural dispute among scientists. But what are scientists to do? No matter how judiciously they present their views, no matter how technical the journal, their statements can always be misused by those whose political or religious convictions outweigh considerations of intellectual integrity. If nothing else Clark's history of Darwinism shows that scientific disputes continue, as do marriages and divorces according to Dr Pangloss, in happy repetition. □

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The conversation continued

Philip Kitcher

The Nature of Selection: Evolutionary Theory in Philosophical Focus.

By Elliott Sober.

MIT Press:1984. Pp.383. \$33.75, £30.

VIRTUALLY no philosopher is immune to the fear of irrelevance. Despite the reassurance that one is grappling with problems that have challenged the Western intellectual tradition since the time of the Greeks, there is always the quiet voice that asks "Does anyone care?". So it is tempting to announce that philosophy is — and perhaps has always been — the servant of the sciences, and to immerse oneself in the theoretical problems that arise within some more self-confident domain of inquiry. Even this may not put an end to the whispered doubts. If philosophers turn meta-scientists, do they manage to contribute anything that a reflective practitioner could not have achieved more easily? Is philosophy only useful when it tidies the corners that talented scientists are too busy to set in order for themselves?

A long and distinguished tradition in the philosophy of science reveals the impact of combining philosophical understanding with deep knowledge of the sciences. The tradition is strongest in the philosophy of physics, where reflections on space, time, cause and chance have proven valuable both to science and to philosophy. More recently, there has been a fruitful alliance between philosophy and psychology, in which students of cognitive science have looked to philosophers for conceptual guidance, offering in return new perspectives on old problems about mind, language and knowledge. The publication of Elliott Sober's new book shows that biology's turn has now come.

On reading a draft of *The Nature of Selection* in the autumn of 1983, I formed the opinion that it would illuminate both biology and philosophy. That impression is amply confirmed by study of the published version. Sober has focused evolutionary theory for philosophers, and thereby provided new material for inquiry into the general problems of the philosophy of science, the problems of explanation, confirmation and theory structure. He has also addressed a number of major conceptual problems that currently confront practising biologists. In his hands, some disputes about natural selection are reformulated; others are dissolved.

Sober's main project is to understand the causal notions that figure in evolutionary theory. He starts from the conviction that many contemporary debates about the evolutionary process persist because the protagonists have failed to understand the character of the causal claims that they and

their opponents are making. The first part of the book is devoted to an analysis of the concepts of selection, adaptation and fitness, and to a delineation of the role that these concepts — as well as the concept of chance — play in evolutionary theory. The second part develops the analysis in the context of a dispute to which Sober has made substantial contributions, the controversy about units of selection. Substantial though that previous work was, the present discussion supersedes it.

On Sober's account, evolutionary theory is best construed as a theory of forces. Evolution is a process in which typically (though not invariably) gene frequencies change along a lineage, and evolutionary theory attempts to specify the forces that produce the changes. An immediate consequence of this perspective is that the old problem about the evolutionary tautology is broached and quickly disposed of. (Those who are tempted to use the term "tautology" in discussions of evolution ought to be required to read Sober's second chapter.) A more important result is the distinction between selection *of* and selection *for*. Selection of *objects* contrasts with selection for *properties*. The distinction can be made by considering the electorate of the United States. American voters appear to select candidates who are bereft of foresight and understanding. Yet there is no selection for lack of foresight. The property selected for is surely telegenicity.

Although there are several other discussions in the first part of the book that will interest scientific readers, it is probable that they will think of the second part as where the action is. Sober's approach to the problem of units of selection starts with a chapter, allegedly designed to alienate all parties to the controversy, in which he tries to uncover confusions and fallacies in all the major positions. He continues with an analysis that makes explicit appeal to the concept of cause: a necessary condition for X-selection (group selection, genic selection, species selection and so forth) is that there should be some property of Xs that is a positive causal factor on the survival and reproduction of organisms. (Sober eventually generalizes, allowing for entities other than organisms to serve as "benchmarks" of selection.)

However, the concept of cause cannot be

● The Royal Historical Society has published a collection of correspondence to complement Jack Morrell and Arnold Thackray's *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (published in 1981 by Oxford University Press and reviewed in *Nature* 294, 19; 1981).

In *Gentlemen of Science: Early Correspondence* Morrell and Thackray have gathered together "what [they] judge to be the 294 letters of greatest significance to the student of early Victorian science and culture", focusing upon letters written by and to William Vernon Harcourt, a pivotal figure in scientific matters during the early and middle nineteenth century.

taken for granted, and Sober invokes the philosophical literature on probabilistic causation to provide a more detailed analysis. His final suggestion is that *C* is a positive causal factor in the production of *E* in a population, if, for things in the population, the occurrence of *C* does not lower the probability of occurrence of *E* on any background of causally relevant conditions, and raises it on the background of at least one causally relevant background condition. (Roughly: smoking is a positive causal factor in the production of heart attacks if, whatever constellation of traits an individual has, smoking would make that person more prone to have a heart attack.) Sober is aware of the limitations of this analysis, which he forthrightly describes as "circular" (p.291). It would be more appropriate to treat the proposal as a recursion clause for extending our ability to identify positive causal factors. For it is this extended ability that we need to tackle the controversies about units of selection. I shall postpone the question of whether the "circularity" is bothersome.

The last chapter brings the philosophical account of causation to bear on four debates about levels of selection. Sober offers analysis of Dawkins's celebrated rowing analogy, and a diagnosis of why we should not be rushed into thinking that the gene is the one and only unit of selection. However, Sober is careful to point out that his arguments help us understand the idea of "selfish DNA" (developed by Doolittle, Sapienza and others). He also attempts to provide conceptual underpinnings for the claims about macroevolution and "species selection" that have been advanced by Stanley, Gould, Eldredge and Vrba. Here, too, is a discussion of Hamilton's ideas about inclusive fitness and local mate competition, and an extended exploration of proposals about group selection.

The account of inclusive fitness seems to me to be the least useful part of this chapter. Sober starts by suggesting that Hamilton "consolidated an insight that had been available within population genetics for some time" (p.336). Quickly adding that he does not mean that Hamilton underwrote Haldane's apocryphal quips about sacrificing himself for two brothers or eight cousins, Sober continues by reminding us that the fitness of a trait is standardly defined as the average fitness of the bearers. So Hamilton's insight can be reduced to a rather elementary idea: "There are many ways for a gene to be advantageous *on average*" (p.336).

This evaluation strikes me as parallel to the view that Darwin consolidated an insight of Malthus. Hamilton does not seem primarily interested in identifying the fitnesses of individual alleles or of allelic pairs. (That approach was later adopted by Dawkins, and is the target of much of Sober's criticism.) Inclusive fitness was introduced because of the apparent inadequacy of the classical notion of fitness for

phenotypic traits, an inadequacy that is most obvious in traits that reduce the expected reproductive success of their bearers. When we average over the set of individuals with any such phenotype we are likely to find that the (classical) fitness lies below the mean for the population. For the lucky recipients, the kin whose reproductive success is boosted by the fact that others have the phenotypic trait in question, *are not themselves bearers of the trait*. They only enter into the set over which it is appropriate to average when we compute the chances for spreading the gene(s) that underlie the phenotypic trait, and thus calculate — as Haldane did in rough-and-ready fashion, and as Hamilton did systematically — the way in which reduced genetic representation through descendants is offset by increased genetic representation through kin.

In general, I find Sober's discussion of inclusive fitness confusing because his use of "altruist" can cover both individuals who bear genes that might (in the right circumstances or in the right combination) dispose them to sacrifice their own reproductive interests to those of others, and individuals who actually do make these sacrifices. The treatment of group selection is another story. Sober's analysis of this tricky notion is one of the high points of the book.

The distinction between group and individual selection is introduced with an apt example. We are to imagine a set of internally homogeneous populations with different average heights. We observe that tall individuals are reproductively more successful than short ones. We note also that groups of taller individuals leave more descendants than groups of shorter individuals. How do we tell if we have a case of individual selection or a case of group selection?

Everything turns on whether the causally relevant factor is the property of being tall or of being in a group with a large average height. To recognize the difference, we shall need to consider a larger ensemble of populations, asking how short individuals would have fared if they had found themselves in tall groups, and so forth. The probabilistic treatment of causality allows the conditions to be stated precisely.

Sober's work will have been done if the controversies about group selection can now be resolved by appeal to the empirical evidence. There is one obvious possible snag. The probabilistic conditions bear reference to causally relevant background conditions. If reductionists and anti-reductionists disagree on the properties that can be invoked as genuine causally relevant background conditions, then Sober's analytic apparatus may fail to bring resolution. Faced with a putative case of group selection, the reductionists produce what they are happy to count as a causally relevant property of individuals, given which the group characteristic makes no difference to the probability of survival

and reproduction. If their opponents contend that the alleged property is contrived, an artefact rather than a genuine cause, then Sober's analysis will have to be extended by explicating the notion of a causally relevant background condition. So we cannot tell in advance if all the conceptual work has been done. But even pessimists should be confident that Sober has taken us a long way forward.

The Nature of Selection is not merely a book that clarifies dramatically some vexed issues. It also points to new questions and, perhaps, to refinements of causal notions that it introduces. In its achievement and in its open-endedness it deserves comparison with the work that Sober singles out as having started his own train of thought. George Williams's *Adaptation and Natural Selection* has been important to philosophers as well as to biologists for its combination of biological insight and philosophical acumen. Sober's is the answering philosophical voice, the voice of a first-rate philosopher and a knowledgeable student of contemporary evolutionary theory. His book, like Williams's, merits broad attention among both communities. It should also inspire others to continue the conversation. □

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